PATENT ABSTRACTS OF JAPAN

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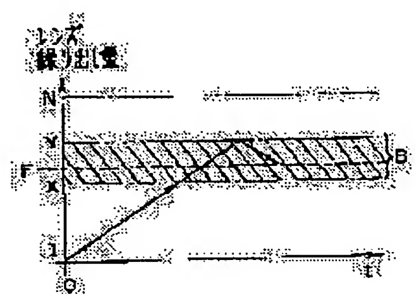
(54) AUTOMATIC FOCUSING DEVICE

(57)Abstract:
PURPOSE: To fix a photographing lens at a focusing position in a short time and with high accuracy.
CONSTITUTION: The moving area of th photographing lens in the case of active system automatic focusing is set. First, active system range-finding using a photodetector(PSD) is executed. Based on the range-finding data thereof, the photographing lens is moved to one end part X of the prescribed moving area B. Next, contrast system automatic focusing is executed. That means, focus voltage data corresponding to the contrast of a video signal is detected in the area B while the photographing lens is moved toward the other end part Y by prescribed amount. When the detection of the focus voltage data is finished to the other end part Y, the maximum value of the focus voltage data is detected and the photographing lens is moved to the position (focusing position F) where the maximum value is obtained.



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[Patent number]	
[Date of registration]	
[Number of appeal against examiner's decision of rejection]	2001-18418
[Date of requesting appeal against examiner's decision of rejection]	12.10.2001

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CLAIMS

[Claim(s)]
[Claim 1] An automatic-focusing adjustment characterized by having a means to perform ranging to a photographic subject in a coarse predetermined precision, and to appoint a migration field of a taking lens based on ranging data, a means to acquire contrast of a video signal, moving a taking lens into the above-mentioned migration field, and a means to position a taking lens in a location where the above-mentioned contrast becomes the largest.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is prepared in an electronic camera and relates to the automatic-focusing adjustment which controls a taking lens in a focus location.
[0002]
[Description of the Prior Art] Conventionally, the infrared active method and the contrast detection method are learned as automatic-focusing accommodation of an electronic camera. An infrared active method irradiates infrared radiation to a photographic subject, and performs ranging by the principle of triangulation by detecting the reflected ray by location sensing elements, such as PSD. In this method, although the precision of this ranging data is low since the magnitude of the output signal of location sensing elements, such as PSD, is divided into some phases and it is considering as ranging data, the time amount which can let out a taking lens at a stretch in the field based on this ranging data, and focus actuation takes is short. On the other hand, a contrast detection method uses the property in which the high frequency component of a video signal increases most in a focus condition, by photography of one photographic subject. That is, this method moves a taking lens little by little, and detects the high frequency component of a video signal, the location of a taking lens is set that this high frequency component becomes max, and a highly precise focus is performed.

[0003]
[Problem(s) to be Solved by the Invention] In an infrared active method, when a taking lens is not correctly set to the position in the field chosen for the mechanical error etc. (for example, center position of the field) and it has separated greatly from the location corresponding to photographic subject distance with the actual lens location, there is a possibility that an image with a focus may not be acquired. Moreover, in order that it may detect the focus location of a taking lens by the mountain-climbing method and may compare many data, a contrast detection method has the problem of taking time amount before acquiring a focus condition, when a taking lens is in a location distant from a focus location especially. This invention solves such a problem at once, and aims at obtaining the automatic-focusing adjustment which is a short time and can set a taking lens to high degree of accuracy in a focus location.
[0004]
[Means for Solving the Problem] An automatic-focusing adjustment concerning this invention performs ranging to a photographic subject in a coarse predetermined precision, and is characterized by to have a means to appoint a migration field of a taking lens, a means to acquire contrast of a video signal, moving a taking lens into the above-mentioned migration field, and a means position a taking lens in a location where the above-mentioned contrast becomes the largest, based on ranging data.
[0005]
[Example] Below, an illustration example explains this invention. <u>Drawing 1</u> shows the circuitry of the automatic-focusing adjustment of the electronic camera which applied one example of this invention.
[0006] Image formation of the image of a photographic subject is carried out to an image sensor (CCD) 12 through a taking lens 11. The video signal outputted from an image sensor 12 is processed

by the correlation duplex sampling (CDS) circuit 13, for example, the reset noise at the time of signal detection etc. is removed. After this, the AD translation of the video signal is carried out by A-D converter 14, and it is inputted into the Rhine memory 15 and a digital filter 16, respectively.
[0007] The Rhine memory 15 carries out the sequential storage of the data of 1 horizontal scanning line of a video signal, and carries out the sequential output of this in the process circuit 17. In the process circuit 17, gamma amendment processing is performed to the data of 1 horizontal scanning line, and it is recorded on a magnetic disk (not shown) by the image transcription regenerative circuit 18. In addition, A-D converter 14, the Rhine memory 15, the process circuit 17, and the image transcription regenerative circuit 18 are controlled by the control circuit 21 equipped with the microcomputer.
[0008] A digital filter 16 acts as a high-pass filter, both the waves detector circuit, and an integrating circuit. That is, a component positive [of the signal of this high frequency component] and negative is arranged in the same direction, and a digital filter 16 detects it, and integrates with this detection signal while it takes out a high frequency component by differentiating the video signal outputted from A-D converter 14. A control circuit 21 asks for a focus location based on this integral value, and carries out point-to-point control of the taking lens 11 so that it may explain in full detail behind. That is, a digital filter 16 outputs the focal voltage data corresponding to the high frequency component of the video signal used in automatic-focusing accommodation of a contrast detection method.
[0009] A motor 22 is controlled by the control circuit 21, and moves a taking lens 11 in the direction of an optical axis. The lens location detector 23 detects the location of a taking lens 11, and outputs this detection result to a control circuit 21. The lens focal distance detector 24 detects a focal distance at the time of zoom actuation of a taking lens 11, and a control circuit 21 asks for depth of field based on this focal distance.
[0010] The active AF module 31 obtains ranging data in automatic-focusing accommodation of an infrared active method, and outputs this ranging data to a control circuit 21. A control circuit 21 moves a taking lens 11 at a stretch to a predetermined location in focus control based on the ranging data obtained from the active AF module 31 so that it may mention later. And performing automatic-focusing accommodation of a contrast detection method, and moving a taking lens 11 the specified quantity every, a control circuit 21 detects the focal voltage data which can be found from the contrast of the video signal outputted from a digital filter 16, and sets a taking lens 11 to the location where this focal voltage data becomes max.
[0011] Drawing 2 shows the configuration of the active AF module 31. A photo detector (PSD) 32 detects distance with a photographic subject by detecting the infrared radiation which glared from the light emitting device (not shown) and was reflected with the photographic subject as everyone knows. That is, ranging is performed by the principle of triangulation, when the magnitude of the output current ratio of a photo detector 32 changes to a linear and detects the value of this current ratio with the light-receiving location of the reflected ray of a photo detector 32. The output current ratio of a photo detector 32 is amplified by the head amplifier 33, and it is amended so that it may become a linear to the inverse number of distance with a photographic subject with logarithmic amplifier 34. Through the buffer amplifier 35, it is inputted into a sample hold circuit 36, fixed time amount maintenance is carried out, and the output signal of logarithmic amplifier 34 is outputted to A-D converter 37. The output signal of A-D converter 37 is distributed and outputted to two or more steps of magnitude in the decoding latch 38. In addition, in the illustration example, although three output terminals are shown to the decoding latch 38, it is constituted so that actual much more output terminals may be prepared, for example, 32 steps of ranging data may be outputted.
[0012] Drawing 3 shows an example of the focus actuation in this example, a horizontal axis shows time amount and an axis of ordinate shows the amount of lens deliveries, respectively.
[0013] In this example, the ranging data outputted from the active AF module 31 as mentioned above has distributed the successive range of a lens to two or more fields corresponding to those with two or more kinds, and this ranging data. The taking lens is movable to the location N corresponding to distance recently from the location I corresponding to infinite distance, and the magnitude of each field (Field B is shown in drawing 3) is set up in consideration of engine performance, the depth of focus, etc. of a taking lens. That is, when, as for the lens migration field B,

a taking lens is located in the center of abbreviation of this field, the depth of focus of a taking lens is set to include the both ends X and Y of that field.

[0014] In the example of drawing 3 , a taking lens is in the location of infinite distance as an initial valve position. It is assumed that the ranging data outputted from the active AF module 31 here supports Field B. A taking lens is made to move at a stretch to the edge X of Field B first in focus actuation. That is, based on the ranging data of an active method, Field B is appointed as a range where a taking lens moves in focus actuation.

[0015] Subsequently, focus actuation of a passive method is performed. That is, the focal voltage data corresponding to the contrast of the video signal acquired through a taking lens is detected, moving a taking lens the specified quantity every into Field B. And the focal voltage data in each location is memorized in the memory of a control circuit 21. After detection of focal voltage data is completed to the edge Y of Field B, next, a taking lens is made to move to the location corresponding to the maximum in the data memorized by memory as a focus location F, and is positioned here.

[0016] Drawing 4 shows the focus working of drawing 3 , and the video signal at the time of focus actuation of an active method especially. The long vertical lines X and Y correspond to the both ends of the field B in drawing 3 , and many short vertical lines Z show the migration timing of a taking lens. That is, between each vertical line, the video signal for one screen is acquired, and contrast is detected about this video signal so that it may mention later.

[0017] An image sensor 12 outputs a video signal every [1/] 60 seconds. The CDS circuit 13 performs predetermined processing to this video signal, and outputs a video signal as shown with Sign K. The wave of this video signal K changes according to the contrast of an image, and its high frequency component increases, so that contrast is large. After the AD translation of this video signal K is carried out, a high frequency component is taken out by differentiating by the digital filter 16. The signal which starts to positive and the negative direction which are shown with Sign L shows this high frequency component. Further, in a digital filter 16, the signal L of this high frequency component arranges a positive and negative component in the same direction, and is detected. It integrates with this detection signal in a digital filter 16, and as Sign M shows, it has the height corresponding to the magnitude of a high frequency component. That is, the height of Signal M becomes large, so that the high frequency component of a video signal K is large.

[0018] Thus, while a taking lens 11 turns the inside of Field B to the other-end section Y from one edge X and moves, one screen of video signals K is acquired at a time every [1/] 60 seconds. And the integral value M corresponding to the contrast of each video signal is stored in the memory of a control circuit 21. After detection of the video signal in Field B is completed, in a control circuit 21, maximum is detected out of the integral value M stored in memory, and a taking lens 11 stops towards Edge X in the location corresponding to return and this maximum from Edge Y. Maximum is shown by the sign M1 in the example of drawing 4 .

[0019] As mentioned above, this example moves a taking lens 11 at a stretch to the edge X of the predetermined field B with an active method first, and subsequently, moving a taking lens 11 the specified quantity every with a passive method, it is constituted so that focal voltage data may be detected. Thus, since this example is what performs highly precise focus actuation by the passive method [in the limited field] after moving a taking lens 11 beforehand to the field near a focus location, a taking lens will be correctly set to a focus location, and the image which always had the focus will be acquired. Moreover, time amount is not taken to obtain a focus even if the initial valve position of a taking lens 11 is in a location distant from a focus location.

[0020] Furthermore, in case a taking lens 11 moves in Field B, after detecting a video signal from the edge X of the direction near the initial valve position of a taking lens 11 and completing detection to the edge Y of a far side, this example is constituted so that a taking lens 11 may be returned to the location of maximum M1. Therefore, a taking lens 11 does not go and come back to the inside of Field B at most one time, and the migration length is stopped to the minimum.

[0021] Moreover, in this example, the time interval to which a video signal is outputted from an image sensor 12 is regularity (1 / 60 seconds). Therefore, when the delivery speed of a taking lens 11 is fixed, in a short distance with the large amount of deliveries, resolution becomes high, and the precision of focus control of the taking lens 11 especially at the time of macro photography

improves.
[0022] Thus, this example equipment can carry out automatic-focusing accommodation to a short time and high degree of accuracy over the photographic subject distance whole region by the easy configuration to the automatic-focusing adjustment equipped with the focus control unit of a passive method.
[0023] In addition, this invention can be applied not only to an electronic "still" camera but to a movie camera, and can also be prepared in the further usual still camera. Moreover, there may not be a limit of the initial valve position of a taking lens 11, may be a short distance side, and may be a location between infinite distance and a short distance.
[0024]
[Effect of the Invention] As mentioned above, according to this invention, it is a short time and the effect that a taking lens can be set to high degree of accuracy in a focus location is acquired.

[Translation done.]

* NOTICES *

TECHNICAL FIELD

[Industrial Application] This invention is prepared in an electronic camera and relates to the automatic-focusing adjustment which controls a taking lens in a focus location.

[Translation done.]

PRIOR ART

[Description of the Prior Art] Conventionally, the infrared active method and the contrast detection method are learned as automatic-focusing accommodation of an electronic camera. An infrared active method irradiates infrared radiation to a photographic subject, and performs ranging by the principle of triangulation by detecting the reflected ray by location sensing elements, such as PSD. In this method, although the precision of this ranging data is low since the magnitude of the output signal of location sensing elements, such as PSD, is divided into some phases and it is considering as ranging data, the time amount which can let out a taking lens at a stretch in the field based on this ranging data, and focus actuation takes is short. On the other hand, a contrast detection method uses the property in which the high frequency component of a video signal increases most in a focus condition, by photography of one photographic subject. That is, this method moves a taking lens little by little, and detects the high frequency component of a video signal, the location of a taking lens is set that this high frequency component becomes max, and a highly precise focus is performed.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, according to this invention, it is a short time and the effect that a taking lens can be set to high degree of accuracy in a focus location is acquired.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In an infrared active method, when a taking lens is not correctly set to the position in the field chosen for the mechanical error etc. (for example, center position of the field) and it has separated greatly from the location corresponding to photographic subject distance with the actual lens location, there is a possibility that an image with a focus may not be acquired. Moreover, in order that it may detect the focus location of a taking lens by the mountain-climbing method and may compare many data, a contrast detection method has the problem of taking time amount before acquiring a focus condition, when a taking lens is in a location distant from a focus location especially. This invention solves such a problem at once, and aims at obtaining the automatic-focusing adjustment which is a short time and can set a taking lens to high degree of accuracy in a focus location.

[Translation done.]

MEANS

[Means for Solving the Problem] An automatic-focusing adjustment concerning this invention performs ranging to a photographic subject in a coarse predetermined precision, and is characterized by to have a means to appoint a migration field of a taking lens, a means to acquire contrast of a video signal, moving a taking lens into the above-mentioned migration field, and a means position a taking lens in a location where the above-mentioned contrast becomes the largest, based on ranging data.

[Translation done.]

EXAMPLE

[Example] Below, an illustration example explains this invention. Drawing 1 shows the circuitry of the automatic-focusing adjustment of the electronic camera which applied one example of this invention.
[0006] Image formation of the image of a photographic subject is carried out to an image sensor (CCD) 12 through a taking lens 11. The video signal outputted from an image sensor 12 is processed by the correlation duplex sampling (CDS) circuit 13, for example, the reset noise at the time of signal detection etc. is removed. After this, the AD translation of the video signal is carried out by A-D converter 14, and it is inputted into the Rhine memory 15 and a digital filter 16, respectively.
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[0010] The active AF module 31 obtains ranging data in automatic-focusing accommodation of an infrared active method, and outputs this ranging data to a control circuit 21. A control circuit 21 moves a taking lens 11 at a stretch to a predetermined location in focus control based on the ranging data obtained from the active AF module 31 so that it may mention later. And performing automatic-focusing accommodation of a contrast detection method, and moving a taking lens 11 the specified quantity every, a control circuit 21 detects the focal voltage data which can be found from the contrast of the video signal outputted from a digital filter 16, and sets a taking lens 11 to the location where this focal voltage data becomes max.
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ratio with the light-receiving location of the reflected ray of a photo detector 32. The output current ratio of a photo detector 32 is amplified by the head amplifier 33, and it is amended so that it may become a linear to the inverse number of distance with a photographic subject with logarithmic amplifier 34. Through the buffer amplifier 35, it is inputted into a sample hold circuit 36, fixed time amount maintenance is carried out, and the output signal of logarithmic amplifier 34 is outputted to A-D converter 37. The output signal of A-D converter 37 is distributed and outputted to two or more steps of magnitude in the decoding latch 38. In addition, in the illustration example, although three output terminals are shown to the decoding latch 38, it is constituted so that actual much more output terminals may be prepared, for example, 32 steps of ranging data may be outputted.

[0012] Drawing 3 shows an example of the focus actuation in this example, a horizontal axis shows time amount and an axis of ordinate shows the amount of lens deliveries, respectively.

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[0014] In the example of drawing 3 , a taking lens is in the location of infinite distance as an initial valve position. It is assumed that the ranging data outputted from the active AF module 31 here supports Field B. A taking lens is made to move at a stretch to the edge X of Field B first in focus actuation. That is, based on the ranging data of an active method, Field B is appointed as a range where a taking lens moves in focus actuation.

[0015] Subsequently, focus actuation of a passive method is performed. That is, the focal voltage data corresponding to the contrast of the video signal acquired through a taking lens is detected, moving a taking lens the specified quantity every into Field B. And the focal voltage data in each location is memorized in the memory of a control circuit 21. After detection of focal voltage data is completed to the edge Y of Field B, next, a taking lens is made to move to the location corresponding to the maximum in the data memorized by memory as a focus location F, and is positioned here.

[0016] Drawing 4 shows the focus working of drawing 3 , and the video signal at the time of focus actuation of an active method especially. The long vertical lines X and Y correspond to the both ends of the field B in drawing 3 , and many short vertical lines Z show the migration timing of a taking lens. That is, between each vertical line, the video signal for one screen is acquired, and contrast is detected about this video signal so that it may mention later.

[0017] An image sensor 12 outputs a video signal every [1/] 60 seconds. The CDS circuit 13 performs predetermined processing to this video signal, and outputs a video signal as shown with Sign K. The wave of this video signal K changes according to the contrast of an image, and its high frequency component increases, so that contrast is large. After the AD translation of this video signal K is carried out, a high frequency component is taken out by differentiating by the digital filter 16. The signal which starts to positive and the negative direction which are shown with Sign L shows this high frequency component. Further, in a digital filter 16, the signal L of this high frequency component arranges a positive and negative component in the same direction, and is detected. It integrates with this detection signal in a digital filter 16, and as Sign M shows, it has the height corresponding to the magnitude of a high frequency component. That is, the height of Signal M becomes large, so that the high frequency component of a video signal K is large.

[0018] Thus, while a taking lens 11 turns the inside of Field B to the other-end section Y from one edge X and moves, one screen of video signals K is acquired at a time every [1/] 60 seconds. And the integral value M corresponding to the contrast of each video signal is stored in the memory of a control circuit 21. After detection of the video signal in Field B is completed, in a control circuit 21, maximum is detected out of the integral value M stored in memory, and a taking lens 11 stops towards Edge X in the location corresponding to return and this maximum from Edge Y. Maximum is shown by the sign M1 in the example of drawing 4 .

[0019] As mentioned above, this example moves a taking lens 11 at a stretch to the edge X of the predetermined field B with an active method first, and subsequently, moving a taking lens 11 the specified quantity every with a passive method, it is constituted so that focal voltage data may be detected. Thus, since this example is what performs highly precise focus actuation by the passive method [in the limited field] after moving a taking lens 11 beforehand to the field near a focus location, a taking lens will be correctly set to a focus location, and the image which always had the focus will be acquired. Moreover, time amount is not taken to obtain a focus even if the initial valve position of a taking lens 11 is in a location distant from a focus location.
[0020] Furthermore, in case a taking lens 11 moves in Field B, after detecting a video signal from the edge X of the direction near the initial valve position of a taking lens 11 and completing detection to the edge Y of a far side, this example is constituted so that a taking lens 11 may be returned to the location of maximum M1. Therefore, a taking lens 11 does not go and come back to the inside of Field B at most one time, and the migration length is stopped to the minimum.
[0021] Moreover, in this example, the time interval to which a video signal is outputted from an image sensor 12 is regularity (1 / 60 seconds). Therefore, when the delivery speed of a taking lens 11 is fixed, in a short distance with the large amount of deliveries, resolution becomes high, and the precision of focus control of the taking lens 11 especially at the time of macro photography improves.
[0022] Thus, this example equipment can carry out automatic-focusing accommodation to a short time and high degree of accuracy over the photographic subject distance whole region by the easy configuration to the automatic-focusing adjustment equipped with the focus control unit of a passive method.
[0023] In addition, this invention can be applied not only to an electronic "still" camera but to a movie camera, and can also be prepared in the further usual still camera. Moreover, there may not be a limit of the initial valve position of a taking lens 11, may be a short distance side, and may be a location between infinite distance and a short distance.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the circuitry of the automatic-focusing adjustment of the electronic camera which applied one example of this invention.
[Drawing 2] It is the block diagram showing an active AF module.
[Drawing 3] It is drawing showing focus actuation of example equipment.
[Drawing 4] It is drawing showing the video signal detected in focus actuation of drawing 3 .
[Description of Notations]
13 CDS Circuit
B The migration field of a lens
F Focus location

[Translation done.]

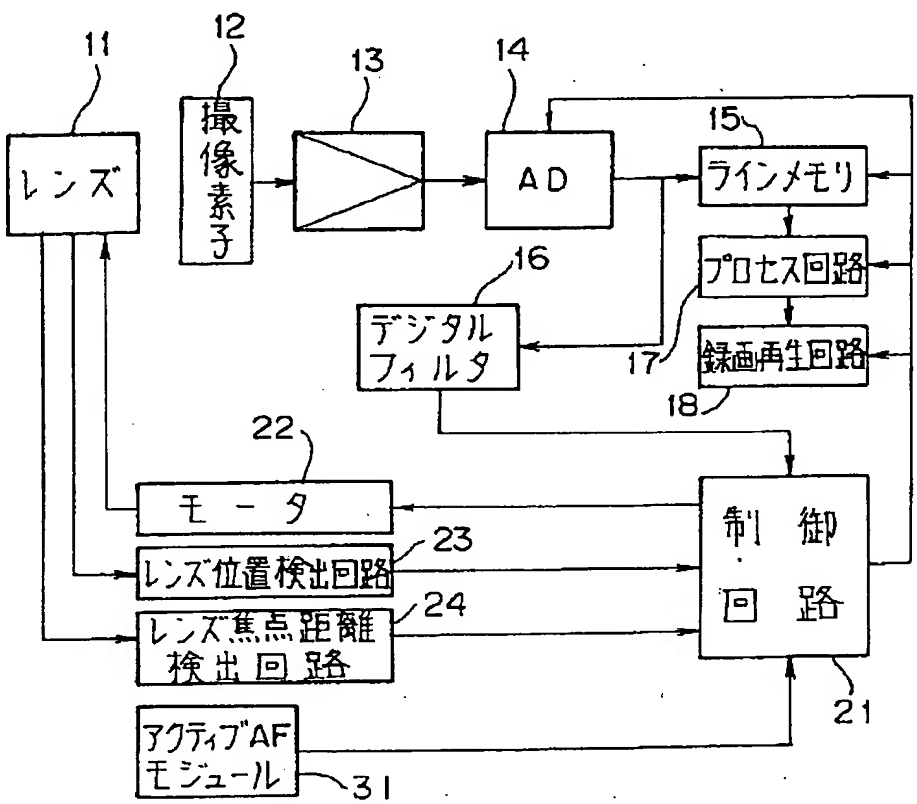
* NOTICES *

Japan Patent Office is not responsible for any damages caused by the use of this translation.

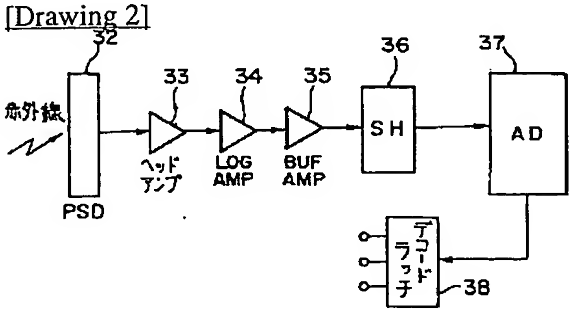
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

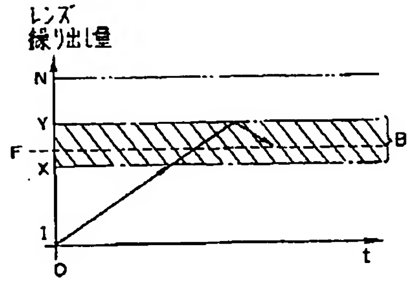
[Drawing 1]



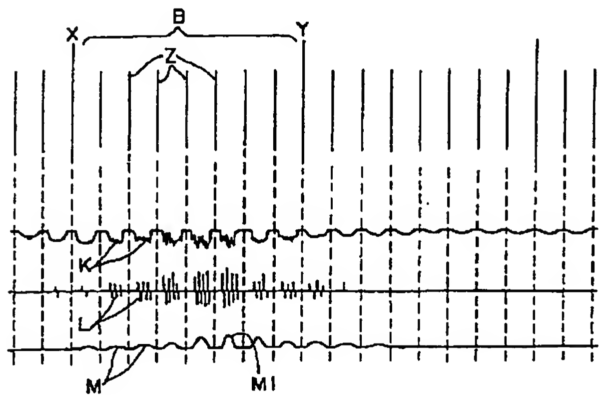
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]